An Inexpensive Biological and Chemical Decontamination Solution from a Powdered Concentrate

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Problem Statement

The potential use of chemical and biological weapons for mass destruction is one of the most serious public health concerns facing the United States. It is now recognized that the U.S. has a limited capacity to defend its national infrastructure and civilian populations from this threat. As a result of the events of September 11, 2001 and subsequent cases of cutaneous and inhalation anthrax, society is particularly fearful of terrorist attacks involving the deliberate release of chemical and biological warfare (CBW) agents. All levels of government and law enforcement are making plans to contain the effects of a terrorist attack using CBW agents.

Safer aqueous-based decontamination formulations have been recently developed to provide CBW decontamination solutions to civilian emergency response personnel. However, these aqueous-based alternatives contain concentrated hydrogen peroxide and an organic cosolvent – two features that are tolerated but not preferred. In addition, some of the decontamination solutions require specialized delivery systems that can add a considerable capital expense and limit access to the technology.

Consequently, an opportunity exists to develop and commercialize a rapid-acting CBW decontamination formulation that is inexpensive, lightweight, easy to prepare, and non-hazardous.

Technology Description

This proposal describes a dry powdered formulation that is dissolved in water to yield a gel-based decontamination formulation. The technology is based on the use of a family of solid peroxides and an inorganic gelling agent to yield a semi-viscous CBW decontaminating solution. Features, advantages, and benefits include:

Destroys Anthrax Spore Surrogate **-** Dilute solutions of oxidant sterilized *Bacillus subtilis* spore-contaminated surfaces (> 6.5 logs) in less than 10 minutes in the presence of considerable organic load.

Destroys Chemical Warfare Agent Surrogates **-** Preliminary data has demonstrated the capability of the oxidant to destroy large amounts of both mustard and VX surrogate in less than 30 minutes.

Easy to prepare and dispense **-** The formulation is simply dissolved in water and dispensed onto the contaminated surface using any readily available delivery system. Sophisticated sprayers or foam generating equipment is not required.

Safe for the user and the environment **-** Delivery of the formulation does not require any additional personal protective equipment other than that required for the particular CBW threat.

Easy to Prepare from Almost Any Water Supply **-** Any potable water supply is of sufficient quality to prepare the decontaminant from the dry-powdered formulation.

Extended Shelf Life **–** The oxidants are extremely stable as demonstrated by an accelerated shelf-life experiment.

Compatible with most materials **-** The formulation is not caustic and does not contain organic solvents that could damage the surface of materials to which it is applied.

Forms a barrier **-** When the formulation is applied it adheres to the surface forming a barrier between the contaminant and the air; containment of "run-off" associated with liquid decontaminants is not necessary.

Inexpensive **–** The synthesis of the oxidant is a simple one-step synthesis. Other components of the formulation are inexpensive bulk industrial chemicals.

Expected Results

Task 1. Optimize the formulation for the destruction of chemical and biological agent surrogates.
An optimal pH for the formulation will be selected; Previous examples of mixed oxidant synergy will be explored and the best mixture of oxidants will be selected for CEES, DEMP, and *Bacillus subtilis* spore decontamination.
Expected Results: Rapid destruction (< 30 min.) of CEES, DEMP, and *Bacillus subtilis* spores without the formation of toxic by-products.

Task 2. Determine the amount of surrogate that is destroyed per unit volume of aqueous formulation.
This task will determine the decontamination potential of the formulation. For CW agents, decontamination will be defined as 99 % destruction of CEES and DEMP in 30 minutes or less. For BW agents, decontamination will be defined as sterilization (no survivors) when a starting with a minimum of 6 logs of *Bacillus subtilis* spores.
Expected Results: A decontamination potential equal or greater than 10 grams of surrogate per liter of decontaminating solution.

Task 3. Determine the capability of the decontamination formulation to decontaminate realistic surfaces.
Surfaces to be tested include bare stainless steel, stainless steel painted with polyurethane paint, bare wood, varnished wood, and concrete.
Expected Results: Comparable performance of the decontamination formulation on non-porous surfaces. Reasonably good performance of porous surfaces.

Potential Environmental Benefits

Society is particularly fearful of terrorist attacks involving the deliberate release of chemical and biological warfare agents into the environment. This fear could be used to intimidate and threaten the United States and its allies into compliance with a request from a terrorist group or hostile nation. In addition, these weapons cost relatively little to produce, are easy to manufacture, and cannot be easily detected making their production and eventual deployment difficult to stop. For these reasons, experts have predicted that the probability of *preventing* additional chemical and biological terrorism is very low.
Consequently, all levels of government and law enforcement are making plans to contain the effects of a terrorist attack using CBW agents and limit its impact on the environment. An important containment strategy is to enable emergency response personnel (police, fire fighters, etc.) to neutralize the threat using decontamination methods. Most CBW agents can be destroyed or rendered harmless by suitable chemical treatments1 and having a high decontamination capacity offers many benefits. On-site safety can be enhanced, allowing emergency personnel to operate safely in the contaminated zone while the injured are being treated and evacuated. Effective decontamination strategies would also enable post-incident clean-up to be carried out rapidly with less damage to property and having a high decontamination capacity can make the weapon less efficient, therefore less able to shock the public. As a result, these chemical and biological weapons would become less attractive to a terrorist group and the tendency for proliferation of CBW agents would be reduced.

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